

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE**NUMBER: 02-2A-011106 -X****SUBSYSTEM NAME:** FLIGHT CONTROL MECH - RUDDER / SPEED BRAKE**REVISION:** 1 06/29/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	: RUDDER/SPEEDBRAKE (R/SB) SUNDSTRAND	MC621-0053-0068 5004918B
LRU	:HYDRAULIC VALVE MODULE MOOG	MC621-0073-0001 A23830-2
SRU	:POWER VALVE	A24150

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

POWER VALVE (TWO PIECE END CAP ASSEMBLIES)

QUANTITY OF LIKE ITEMS: 2

ONE POWER VALVE FOR THE RUDDER AND ONE FOR THE SPEEDBRAKE

FUNCTION:

THREE SPRING CENTERED SPOOL VALVES, MECHANICALLY TIED TOGETHER AND PRESSURE ACTUATED, EACH METER HYDRAULIC FLUID FROM ONE HYDRAULIC SYSTEM TO A RUDDER OR SPEEDBRAKE HYDRAULIC MOTOR.

FAILURE MODES EFFECTS ANALYSIS FMEA -- CIL FAILURE MODE

NUMBER: 02-2A-011106- 01

REVISION#: 2 06/29/01

SUBSYSTEM NAME: FLIGHT CONTROL MECH - RUDDER / SPEED BRAKE

LRU: HYDRAULIC VALVE MODULE

CRITICALITY OF THIS

ITEM NAME: POWER VALVE

FAILURE MODE: 1/1

FAILURE MODE:

FAILS IN DRIVE OPEN/DRIVE CLOSED POSITION

MISSION PHASE: DO DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR
POWER VALVE WITH 2-PIECE END CAP ONLY

CAUSE:

MECHANICAL FAILURE, SEIZED (HYDRAULIC FLUID OVERTEMPERATURE), CONTAMINATION, EXCESSIVE SPOOL STOP MOVEMENT FROM POWER SPOOL END CAP

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN A) N/A
B) N/A
C) N/A

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

LOSS OF CONTROL OF HYDRAULIC POWER TO THREE HYDRAULIC MOTORS, RESULTING IN LOSS OF RUDDER OR SPEEDBRAKE FUNCTIONS. SURFACE CONTINUES TO MOVE AT LAST COMMANDED RATE TO POWER DRIVE UNIT (PDU) STOPS WHEN FAILED IN DRIVE OPEN POSITION.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE**NUMBER: 02-2A-011106- 01****(B) INTERFACING SUBSYSTEM(S):**

LOSS OF CONTROL OF AEROSURFACE.

(C) MISSION:

LOSS OF MISSION, CREW/VEHICLE.

(D) CREW, VEHICLE, AND ELEMENT(S):

LOSS OF CONTROL OF AEROSURFACE MAY RESULT IN LOSS OF CREW/VEHICLE

-DISPOSITION RATIONALE-

(A) DESIGN:

HYDRAULIC FLUID ENVIRONMENTALLY CONTROLLED. DESIGNED TO OPERATE AT +275 DEG F. 5 MICRON HYDRAULIC SYSTEM/15 MICRON AND 35 MICRON HYDRAULIC VALVE MODULE FILTRATION FOR REMOVAL OF POTENTIALLY JAMMING CONTAMINANTS. 500# BREAKOUT FORCE AVAILABLE TO SHEAR CONTAMINATION. FORCE IS VERIFIED BY ANALYSIS REF: MOOG STRUCTURAL ANALYSIS REPORT DATED AUG 22, 1977. SPOOL SLEEVE MFG/MAINTAINED AS MATCHED SET.

TWO SPOOL STOP CLOSURES ARE USED PER POWER VALVE TO LIMIT THE MOVEMENT OF THE POWER SPOOL TO 0.060" AT EACH END. THE ORIGINAL POWER SPOOL CLOSURE STOP WAS A TWO PIECE DESIGN CONSISTING OF A CRES STEEL SPOOL STOP PRESS FIT INTO AN ALUMINUM (6061-T6) END CAP. THIS TWO-PIECE CONFIGURATION HAD THE TENDENCY TO TRAP LUBE OIL/AIR BEHIND THE SPOOL STOP DURING THE PRESS-FIT OPERATION, MAKING IT DIFFICULT TO PRESS THE STOP COMPLETELY INTO THE END CAP. THIS MANUFACTURING ISSUE REPRESENTS A CONCERN, AS AN UNSEATED SPOOL STOP HAS THE POTENTIAL FOR FURTHER DISPLACEMENT FROM THE END CAP AND OVER TIME CAN RESTRICT THE FREE MOVEMENT OF THE POWER SPOOL. THE SUPPLIER (MOOG) RESOLVED THIS MANUFACTURING ISSUE IN 1983 BY INCORPORATING A FLAT ALONG THE CIRCUMFERENCE OF THE SPOOL STOP TO VENT LUBE OIL/AIR PRESSURE TRAPPED BETWEEN THE SPOOL STOP AND END CAP. CURRENT FLEET USES BOTH VENTED AND UNVENTED SPOOL STOPS. THE UNVENTED SPOOL STOPS DESIGN IS NO LONGER MANUFACTURED AND WILL BE RETIRED BY ATTRITION.

(B) TEST:

QUALIFICATION TESTS: THERMAL VACUUM FROM -40 DEG F TO +275 DEG F. THERMAL CYCLE -40 DEG F TO +275 DEG F, 100,000 PRESSURE IMPULSE CYCLES. PULL LIFE/LIMIT LOAD(400 MISSION DUTY CYCLES).

ACCEPTANCE TESTS: ACCEPTANCE TEST PROCEDURE (ATP) - THERMAL CYCLE TEST. POWER DRIVE UNIT (PDU) ACCEPTANCE TEST - CLEANLINESS LEVEL 190, PERFORMANCE TEST.

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GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION
RAW MATERIAL CERTIFICATIONS VERIFIED. SPECIAL MATERIAL REQUIREMENTS ARE IDENTIFIED IN CERTIFICATIONS.

NONDESTRUCTIVE EVALUATION
PIECE PARTS EVALUATED BY SELECTED PENETRANT, MAGNETIC PARTICLE, ULTRASONIC, AND RADIOGRAPHIC INSPECTIONS.

SPECIAL PROCESSES
CRITICAL/CLOSE TOLERANCE DIMENSIONS AND FINISHES ARE 100 PERCENT INSPECTED FOLLOWING MACHINING.

CONTAMINATION CONTROL
ASSEMBLY AREA CLEANLINESS IS VERIFIED PER CONTAMINATION CONTROL PLAN. COMPONENTS ARE PRECLEANED PRIOR TO ASSEMBLY. PARTS AND TOOLS/AIDS ARE CLEANED PRIOR TO ASSEMBLY. END ITEM FLUID SAMPLE IS VERIFIED PRIOR TO ACTUATOR DELIVERY.

TESTING
ROCKWELL DESIGN AND QUALITY PERSONNEL, WITH NASA PARTICIPATION, CONDUCT A DETAILED ACCEPTANCE REVIEW OF THE HARDWARE AT THE VENDOR'S FACILITY, PRIOR TO THE SHIPMENT OF EACH END ITEM COVERED BY CONTROL PLAN. ATP VERIFICATION IS MIP FOR RI QA REPRESENTATIVE.

(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATA BASE.

(E) OPERATIONAL USE:

NONE.

- APPROVALS -

SAFETY ENGINEERING	: R. STELL	:_/S/ R. STELL_____
SAFETY ENGINEERING ITM	: P.A. STENGER-NGUYEN	:_/S/ R. STELL, FOR_____
HYDRAULICS ENGINEER	: W. VARGAS	:_/S/ W. VARGAS_____
HYDRAULICS SSM	: S. NAMVARI	:_/S/ S. NAMVARI_____

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL FAILURE MODE

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MOD	: J. DAVIS	:_/S/ J. DAVIS_____
USA SAM	: M. J. BURGHARDT	:_/S/ M. J. BURGHARDT_____
USA	: S. LITTLE	:_/S/ J. WILDER, FOR_____